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surface. At Key Largo the reef has "a probable width of at least nine miles from the outer reef patches." Very great weight is given to solutional action. Not only are the Everglades in great measure explained by it, but the sounds and mud flats between the line of keys and the mainland. The disconnection is increasingly great southward, until between Key West and Cape Sable the mud flats and mangrove islands "are all that give evidence of the former continuity of the land." Thus Florida is constantly losing territory, instead of gaining it, as the older views maintained. The Marquesas, formerly considered an atoll built upon a raising bank, are, according to the author, merely a very perfect sound, and the "lagoon" is an area of greater solution. Mr. Griswold, however, does not carry the solutional theory to the extent to which it is borne by the senior author.

In many places on the keys the elevated reef is capped by an oölite. Mr. Agassiz states positively its æolian origin; but Mr. Griswold, who was last on the ground, says that, for several reasons, which he enumerates, "the topography favors an origin for the limestone in water." This guarded statement does not seem too strong for the evidence presented. This oölite was traced by Mr. Griswold much farther into the Everglades than any geologist has penetrated heretofore. Mr. Agassiz interprets the formation as modified dune sand, obtained from the beaches of the elevated reef, and blown inland by prevailing east winds.

J. EDMUND WOODMAN.

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*Correlation of Erie-Huron Beaches with Outlets and Moraines in Southeastern Michigan.* By F. B. TAYLOR. Bull. Geol. Soc. America, Vol. VIII, pp. 31-58, with map.

In this paper there is given an account of observations in a region hitherto little studied but containing evidences of a most interesting glacial and postglacial history. As stated in the title, the paper deals with features observed in southeastern Michigan chiefly in the northward projecting portion between Saginaw Bay and the lower end of Lake Huron, commonly called the "Thumb." Having spent two months during the past season in geological investigations in this region the reviewer is prepared to lend corroborative evidence as to the general conclusions of the paper and to testify to the scientific acumen displayed in the interpretation of the phenomena observed. The paper constitutes the first published account of detailed observa-

tions of glacial phenomena in this portion of the state. Almost the entire region is heavily covered with glacial drift. Very few outcrops of country rock occur. All the moraines of the region show two distinct phases. Above a contour of approximately 200 feet, which marks the upper limit of submergence, they have an irregular rolling surface, while below this line they lose their irregular features and are in fact so subdued as often to be distinguished with difficulty from the ground moraine. These water-laid moraines, however, are distinct though faint topographic features and mark the former position of the ice front as surely as the hilly land laid form.

In the paper cited a description is given of all the different moraines and beaches formed in this part of the state though the chief interest centers in those found in Sanilac and adjoining counties. In the vicinity of Imlay City a channel occupied by a swamp and bounded by beach lines was discovered extending north and west past this place and North Branch, then southwestward toward Flint. This, called the Imlay Outlet, is regarded as the outlet of a lake (unnamed) at the time the ice foot rested on its northern side. The position of the ice front is marked by a rugged moraine--the Toledo moraine.

On the retreat of the ice from this position there was next formed the Detroit moraine which, except for a tract near Yale is nearly all water laid. North of Yale near Melvin it is represented by kames and kame moraines. In this area which the author of the paper did not examine we have observed a well-marked series of kame ridges marking the northernmost limit of the eastern limb of the Detroit moraine. Northward the land fades away into the great swamp which extends north from Capac past Valley Center and Brown City to Shabona Post Office and into the almost imperceptible divide between this and the Black River swamp toward the east.

The last moraine is the Port Huron Saginaw moraine which extends from a point six or eight miles northwest of Port Huron along the east side of Black River to Tyre, thence curving around toward the southwest to Vassar. From the 200 feet contour, around the northern and eastern side of this moraine, the land slopes evenly away toward the present shore. West of the eastern limb of this moraine lies the great Black River swamp.

As the ice front retreated over this swamp region to its last halting stage at the Port Huron-Saginaw moraine, the water from the wasting glacier evidently found its way westward along the ice front, the posi-

tion of several of these outlets being noted. The last of these, the Uby channel, was the most important. The position of this channel is now marked by the north branch of Cass River, a small stream flowing in a wide valley filled with valley gravels. At Tyre, a branch was received from the southeast. The relation of a great ice dam and the outlet of the waters is here admirably shown. The evidence of reversed drainage in the case of Black River is unmistakable. Previous to the opening of the Uby channel when the ice-front was on the south side of the north branch of Cass River the outlet which Taylor calls the Cumber spillway was close along its edge. This position is now marked by a long narrow swamp extending from the valley of the Freiburger channel north of Cumber, parallel with the North Branch, southwest across the South Branch of Cass River and on toward Deford. In this swamp is the famous "stone wall" consisting of a low embankment of earth and boulders extending for a considerable distance parallel with the edge of the swamp. Locally it is regarded as the work of pre-historic man. The "wall" is about eighteen inches high and was until recently obscured by vegetable mold. It was exposed by fires in clearing the swamp. Mr. Taylor refers to its resemblance to ice beaches but regards the explanation as unsatisfactory. We spent some time in this vicinity and from a study of the surroundings were convinced that the ice-beach theory is an adequate and the only adequate explanation of the phenomena. It is of interest as constituting the only instance known to us of a boulder wall formed by ice-push in a lake now wholly extinct.

Our own observations on the beach lines of Sanilac county shows a marked northward elevation corresponding to previous observations in the lake region, the result probably of resilience following the withdrawal of the ice and to which was evidently due the reversal of the Black River drainage. This river now flows south and then east into the Saint Clair River at Port Huron. An indication of reversed drainage is seen in the direction of the branches of Black River as, for example, that of Elk Creek which rises in the southwest part of Sanilac county and flows northeast to its junction with Black River which here flows nearly due south.

While Mr. Taylor has carefully described all the glacial features observed by him, and also by G. K. Gilbert who accompanied him on a part of the trip, he has described no eskers. A well-marked example occurs about ten miles northeast of Marlette. It consists of a well-

marked gravel ridge (or "hogback") extending for several miles in a westward direction bearing to the north from the southeast corner of Lamotte township. This was evidently formed at the time the ice front rested on the Detroit moraine. Other interesting features not observed by Mr. Taylor, though suggested by him, are the well-marked kame deposits in the southern part of Sanilac county. In the vicinity of Melvin and Peck they consist of hills and ridges of gravel and sand thirty to fifty feet in height.

The name Erie-Huron is offered for the whole series of lakes represented by all the beaches, while Lake Warren is restricted to one of the separate lakes which most closely corresponds to the original idea of Spencer who proposed the name. Taylor concludes that if the relations of the moraine and beaches have been correctly interpreted then he has found outlets for three and possibly four stages, and these so related to the topography of the region and to the moraines that in at least three cases there is no reasonable doubt as to the contemporary place of the ice front. The continental ice-sheet was obviously the great dam that held all these waters up.

While testifying to the general excellence of the paper we find ourselves unable to follow the author in the degree of confidence he seems to repose in his barometer. As the correlation of some of the beach lines depends upon the identification of beaches having a vertical interval of twenty to forty feet only, and several miles apart and was made by means of a common aneroid barometer, it must be said that the conclusions in some cases are not without an element of doubt. Thus, for example, the Belmore beach is identified near Applegate at an elevation of 770 feet. Forrest Beach six or seven miles east of this has an elevation of about 735 or 740 feet. Near Cass City Mr. Taylor identifies the Du Plain beach which he says is twenty to thirty feet above the Forrest beach. The Belmore and Du Plain though so nearly related are regarded by Mr. Taylor as distinct, while between them he postulates still another stage represented by the Arkona beach which is said to have an elevation of 755 feet northeast of Spring Hill. Allowing for northward rise this beach would have about the elevation given the Belmore beach near Applegate. The question then arises which beach does the Applegate beach represent, the Belmore, Arkona or Du Plain, and what is the actual relation of these to the Forrest beach? Beaches twenty to forty feet above the Forrest beach have been identified with each of these. Our own

barometer readings westward from Croswell gave 765 feet for the altitude of a shore line stated by Mr. Taylor to be 780 feet above sea level. In an area so little diversified, more exact measurements are needed to settle some of the questions raised. Notwithstanding these questions, however, we regard the paper as an important contribution to the literature of the glacial recession. C. H. GORDON.

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*Elementary Geology.* RALPH S. TARR, B.S., F.G.S.A. The Macmillan Company, 1897. Pp. xx+499. \$1.40.

This is the most attractive elementary text-book on geology which the writer has seen. The style is generally simple, the illustrations numerous, well selected, and with but few exceptions clearly reproduced, and the mechanical execution, including the binding, is unsurpassed. The wealth of illustration is shown by the twenty-four full page plates and 268 figures, which adorn its pages. This work differs from most other text-books on geology in the greater stress laid upon the dynamic aspect of the subject. The stratigraphic and historic phases are treated briefly and concisely in 100 pages as against 275 pages given to the dynamic and 92 to the structural side. The development of life during the various periods is outlined, but no attempt has been made to teach palæontology, or to give long lists of fossils. The chapter on the life development precedes the chapter on the evolution of the land and the geography of the different periods. This departure from the more common custom of considering first the geography and then the life of each period will perhaps find favor with some teachers but not with all. Whatever be the success of this arrangement, there can be but little doubt but that the author has done well to lay the greater stress upon the dynamic phases of the subject in a book meant for high-school pupils.

In judging this book due regard must be had for the author's purpose, *i. e.*, to "furnish a companion and adjunct" to his *Physical Geography*. It is his hope that the two books will be used together, the geology being taken after a study of the air and ocean, and before the physiography. Knowing the author's purpose, the omission of some topics, such as "river cycles" and "base levels" can be understood, since they have been treated in the *Physical Geography*. In spite, however, of some omissions, there is considerable repetition in the two books—something hardly to be avoided. The *Geology* is a more ele-